



In the United States Patent and Trademark Office

Appn. Number: 09/312,992
Appn. Filed: 05/17/99
Applicant: Scott E. Johnston
Title: Large Diameter Spirally Formed Pipe
Examiner / GAU: James F. Hook / 3752

TC 3700 MAIL ROOM

JAN 10 2001

RECEIVED

Mailed: December 26, 2000
Cottonwood, CA

Declaration Regarding Prior Art

My Qualifications:

In 1993 I participated at the World Tube Congress in Chicago and was awarded the "Tube Producing Speaker Award" by the "American Tube Association" for my lecture on "Spiral Tube Manufacturing Technology". An article of mine on the same subject was published in "Tube and Pipe Quarterly" around the same time. I am a recognized authority in the art of "Spiral Pipe Manufacturing Equipment", with most of my experience having been with Pacific Roller Die Co., Inc. in Hayward, CA. I was initially hired in 1977 as a Machinery Designer and eventually became their Sales Engineer and CMP (Corrugated Metal Pipe) Sales Manager. From 1993 to 1997 I worked as a consultant, mostly for Pacific Roller Die Co. in much the same capacity. I am currently the president of The Pipe Man Corporation, recently incorporated to promote and manufacture my new portable spiral pipe machinery.

Spiral Pipe Machinery:

There would be no spirally formed pipe, if there were no spiral pipe machinery. Through the years there has been a limited demand for this type of equipment with perhaps 450 machines built world wide, and just a handful of machinery builders. I am quite familiar with the machinery and with many of the companies currently utilizing this equipment to manufacture pipe. These Pipe Mills as they are known in the business, are sold to produce pipes up to twelve feet diameter maximum.

Handbook of Steel Drainage:

The Handbook of Steel Drainage & Highway Construction Products is published by the American Iron and Steel Institute, and was developed primarily as a tool to sell steel products to the construction industry. The National Corrugated Steel Pipe Association (NCSPA) has made it available to civil engineering firms, contractors, and public works officials for many years.

There are a wide variety of products covered, including spirally formed pipes, but spirally formed pipe is not the main focus of the publication. The largest percentage of the reference is dedicated to a product known as structural plate. In the 1960's when America was undergoing significant infrastructure expansion, structural plate products were seen as a time tested proven way to build many types of structures. Structural plate was the ideal product for producing large steel conduits of various types. The photograph on page 26, illustrates the assembly process. Large plates are lifted into place and bolted together to create a giant pipe or arch shape. These plates are easily stacked and shipped to location.

The Handbook of Steel Drainage does not teach of a spirally formed pipe above 144 inches in diameter, or of an arch shape made from a spirally formed pipe above 144 inches in diameter. It is well known within the industry that if you need a larger pipe you must use structural plate. It is well known that spirally formed pipe is produced on factory machinery, and is limited in size by the machine design and shipping restrictions. According to the Rand McNally Motor Carriers' Road Atlas, the legal size limits for interstate and designated routes are: Widths of 102" and Heights up to 14'-6", and according to the California Department of Transportation, Highway Design Manual, Vertical Clearances on major structures for freeways and expressways are set at 16-1/2 feet for new construction, and 15 feet for conventional highways. From these standards you can see that a twelve foot diameter pipe loaded upon a four foot trailer is the absolute maximum you can ship, even with permits (photo copies of this information have been included).

A copy of U.S. Patent 6,000,261 is enclosed, as well as some information regarding application 09/312,990, which is also soon to become a patent. This equipment is absolutely necessary to the

production of large diameter spirally formed pipe. This equipment is new and allows for the production of pipes at the location the pipes will be used.

U.S. Patent 4,852,616 to Holcomb:

Back in 1993, I was on a sales trip to several dozen spiral pipe companies and had the opportunity to visit Mid-State Drainage (Holcomb patent Assignee) in Stockbridge, GA. They have PRD and IMW machines, both of which are limited to producing a maximum of 144 inch diameter pipe. It is inconceivable that Holcomb would consider producing a product beyond the capacity of the machinery in use. It is also well known within the industry that you can not ship a pipe larger than twelve feet in diameter, and so it is inconceivable for this reason as well.

The Holcomb invention specifically addresses spirally formed pipes with fewer corrugations than the standard profiles as identified by the Handbook of Steel Drainage. The assertion being, that for many applications the standard profiles are much stronger than needed. The Holcomb invention has as it's main advantage the reduction in the amount of steel required. The patent specifically addresses corrugation profiles with depths of ½ inch and 1 inch. According to the tables and language provided within the Handbook of Steel Drainage, these corrugation depths are not used for pipe sizes above 120 inches in diameter.

The corrugation profile used is the basis for a pipe's strength. The smallest corrugation profile used with the spiral forming process is found on spiral flexible duct machinery. The corrugation profile for duct has a depth of about 1/8 inch and is not strong enough for use as a buried pipe. The deepest corrugation profiles used with the spiral process have a 1 inch depth. This depth is acceptable for buried pipes up to twelve feet in diameter.

Structural plate is used for larger pipe sizes, the corrugation profile has a depth of 2 inches. Structural plates are made with a 500 ton or larger press, with tooling to form the corrugations and curvature needed for a specific pipe size.

The Holcomb patent discusses the issue of corrugation depths of ½ inch and 1 inch repeatedly, and the drawings provided only refer to these sizes, this is the basis for Holcomb's invention. It is in fact, the basis of spiral pipe machinery as well. Holcomb's reference to the Handbook of Steel Drainage and sizes up to 21 ft in diameter only applies to corrugated metal conduits generally, and specifically speaks to structural plate pipes. This is well known in the industry.

Holcomb in view of the Handbook of Steel Drainage:

The Holcomb patent actually teaches of a pipe product smaller in diameter than the standard sized products made with the same corrugation depths. It does not discuss arching pipes at all. The Handbook of Steel Drainage provides no suggestion expressed or implied that spirally formed pipe could be arched in a size above 120 inches in diameter. The equipment did not exist to produce spiral pipes above 144 inches in diameter, and arch equipment did not exist to arch pipes above 144 inches in diameter.

Conclusion:

My new invention of large diameter spirally formed pipe, is based on two other inventions not known in the prior art. All three inventions are novel and unobvious.

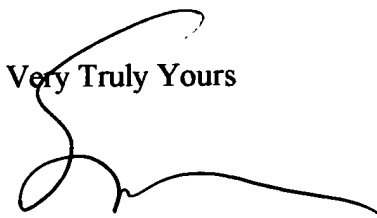
Following my invention of the new portable pipe machine, I realized that many new products would be possible based on larger sizes of spirally formed pipe. First I considered using two giant arch structures to be used instead of a cement bridge structure. I realized that it was actually possible to produce corrugations with depths much greater than had previously been used for producing spirally formed pipes. Other products have been roll formed as deep as 5 to 6 inches. This would open up the size range to incredible possibilities. Then the idea of grain silos, metal buildings and so on, started to come to me, but how many could I patent, how many of these great new inventions would I be able to protect. Then I realized, the invention of large diameter spirally formed pipe is itself patentable. All of these great possibilities speak directly to the fact that this invention is not obvious.

This patent is extremely important. The Spiral Pipe Manufacturing Industry at Large is fully developed, it consists of Corrugated Metal Pipe Producers such as Contech Construction Products, Pacific Corrugated, Lane Metal and so on. There is very little interest in portable pipe machinery from these companies, as they have their machinery, they have their customer base and there is not, in their view enough advantage in producing portable pipe. It is therefore my intention to go into competition with this group.

To do this I intend to become a Franchisor and sell Franchises with exclusive territories throughout the country. It is Extremely Important that I be awarded as Broad of Protection by Patents as Possible. Potential franchisees need to know that they are buying exclusive rights to something that will remain exclusive.

I appreciate your assistance in allowing me the protection afforded this patent. Thank You.

Very Truly Yours

A handwritten signature in black ink, appearing to be 'Scott E. Johnston', written in a cursive style.

Scott E. Johnston

Size Limits for Interstate and Designated Routes

(effective in September, 1990; compiled from data supplied by each state)

LEGAL SIZE

State	Width	Hgt.	Length		
			Semitrailer	Full trailer	Doubles*
Alabama	102" ●●	13'6"	53'	28'6"	Not specified †
Alaska	102"	14'0"	48'	48'	Not specified ‡
Arizona	102"	14'0"	57'6"	28'6"	Not specified †
Arkansas	102"	13'6"	53'6"	28' +	65'
California	102"	14'0"	48' ◇ ◇	28'6"	Not specified †
Colorado	102"	14'6"	57'4"	28'6"	Not specified †
Connecticut	102" ◇	13'6"	48'	28'	Not specified ‡
Delaware	102"	13'6"	53'	Not specified	Not specified #
Dist. of Columbia	102"	13'6"	48'	28'	Not specified ‡
Florida	102"	13'6"	48'	28'	Not specified ‡
Georgia	102"	13'6"	48'	28'	Not specified ‡
Hawaii	108"	13'6"	Not specified	Not specified	65'
Idaho	102"	14'0"	48'	48'	Not specified ○
Illinois	102"	13'6"	53'	28'6"	Not specified †
Indiana	102"	13'6"	53'	53'	Not specified †
Iowa	102"	13'6"	53'	28'6"	Not specified †
Kansas	102"	14'0"	59'6"	28'6"	Not specified †
Kentucky	102"	13'6"	53'	28'	Not specified ‡
Louisiana	102"	13'6"	59'6"	30'	Not specified ††
Maine	102"	13'6" ◆	48'	48'	Not specified †
Maryland	102"	13'6"	48'	28'	Not specified ‡
Massachusetts	102"	13'6"	45'	28'	Unlimited ‡
Michigan	102"	13'6"	53' ○○○	28'6"	Not specified †
Minnesota	102"	13'6"	53' ○○	45'	Not specified †
Mississippi	102"	13'6"	50'	30'	Not specified ††
Missouri	102"	14'0"	53'	Not specified	Not specified ‡
Montana	102"	14'0"	53'	28'6"	Not specified †
Nebraska	102"	14'6"	53'	40'	65'
Nevada	102"	14'0"	48'	28'6"	70'
New Hampshire	102"	13'6"	48'	28'	Not specified ‡
New Jersey	102"	13'6"	48'	28'	Not specified ‡
New Mexico	102"	14'0"	57'6"	28'6"	Not specified †
New York	102"	13'6"	53' ○○	53' ○○	Not specified †
North Carolina	102"	13'6"	53'	28' +	Not specified ‡
North Dakota	102"	13'6"	53'	53'	110'
Ohio	102"	13'6"	53'	28'6"	Not specified †
Oklahoma	102"	13'6"	59'6"	29'	Not specified #
Oregon	102"	14'0"	53'	40;pr	Not specified ◆ ◆
Pennsylvania	102"	13'6"	53'	48'	Not specified †
Rhode Island	102"	13'6"	48'6"	28'6"	Not specified †
South Carolina	102"	13'6"	53' ○○○	28'6"	Not specified †
South Dakota	102"	14'0"	53'	28'6"	81'6" ■
Tennessee	102"	13'6"	50' ■	48'	Not specified †
Texas	102"	13'6"	59'	Not specified	Not specified †
Utah	102"	14'0"	48'	48'	Not specified ***
Vermont	102"	13'6"	48'	28'	Not specified ‡
Virginia	102"	13'6"	53'	28'6"	Not specified †
Washington	102"	14'0"	48'	48'	60' **
West Virginia	102"	13'6"	53' ##	28'6"	Not specified †
Wisconsin	102"	13'6"	48'	53' ○○	Not specified †
Wyoming	102"	14'0"	60'	40'	80' ●

* "Doubles" are a tractor-semi-trailer-full trailer combination

◇ Metric equivalent 102.36"

●● 102" wide vehicles permitted on highways with lane widths of 12' or greater

‡ Length of doubles not specified but trailers are limited to 28' each

† Length of doubles not specified but trailers are limited to 28'6" each

Length of doubles not specified but trailers are limited to 29' each

†† Length of doubles not specified but trailers are limited to 30' each

■ Maximum length of either trailer may not exceed 45'

◆ Height plus 6" of load, for a total of 14'0"

■ Kingpin to rear of trailer

+ 28'6" for trailers operating on 12/1/82

** Overall length is 60' for trailing units including space between

*** Overall length is 61' for trailing units including space between

○ Overall length is 61' for trailing units including space between or 75' overall

● Length of doubles not specified but combined length of trailers not to exceed 80'

◆ Overall length not specified if trailing units, including space between, do not exceed 68' and first semitrailer does not exceed 40'

†† Length limited to 20' from front of first trailer to rear of second trailer

"RAND McNALLY" MOTOR CARRIERS
ROAD ATLAS State Access Po
(as reported by individual states and the F

State	Distance Allowed in Miles from National Network	
Alabama	1 mile	From identi
Alaska	5 miles	Subject to lo
Arizona	See comment	rule does no
Arkansas	Unlimited	sky Beach R
California	1 mile	Access Rd.
Colorado	Unlimited	Up to 102" v
Connecticut	See comment	routes conn.
Delaware	See comment	Unless othe
District of Columbia	See comment	Terminal ac
Florida	See comment	routes from
Georgia	See comment	Unless othe
Hawaii	Unlimited	ordinances
Idaho	See comment	Access beyo
Illinois	5 miles	On US num
Indiana	Unlimited	permit
Iowa	See comment	By permit o
Kansas	Unlimited	From identi
Kentucky	5 miles	signed
Louisiana	10 miles	1 mi. where
Maine	See comment	nated interc
Maryland	See comment	traveled on
Massachusetts	See comment	Unlimited b
Michigan	5 miles	pin setting
Minnesota	See comment	On State hi
Mississippi	Unlimited	routes to p
Missouri	10 miles	to service fa
Montana	Unlimited	(1) 5 miles f
Nebraska	Unlimited	(2) All roads
Nevada	Unlimited	Interstat
New Hampshire	1 mile	3-10 mil.
New Jersey	See comment	populati
New Mexico	See comment	(3) Via IA 10
New York	See comment	All US and
North Carolina	3 miles	On State m
North Dakota	See comment	From legall
Ohio	Unlimited	prohibited
Oklahoma	See comment	.5 mi. urban
Oregon	See comment	routes; yea
Pennsylvania	See comment	side these l
Rhode Island	See comment	Shortest pr
South Carolina	5 miles	mile for foc
South Dakota	Unlimited	By permit o
Tennessee	Unlimited	On State hi
Texas	Unlimited	Via all state
Utah	1 mile	vehicles of
Vermont	See comment	or TNN des
Virginia	Unlimited	
Washington	See comment	
West Virginia	See comment	
Wisconsin	See comment	
Wyoming	See comment	

309.2 Vertical Clearances

(1) Major Structures.

(a) Freeways and Expressways, New Construction--16-1/2 feet shall be the minimum over all portions of the State facility (e.g., main lanes, shoulders, ramps, collector-distributor roads, speed change lanes, etc.).

(b) Freeways and Expressways, Overlay Projects--16 feet shall be the minimum over all portions of the State facility.

(c) Conventional Highways and Local Facilities. All Projects--15 feet shall be the minimum over the traveled way and 14-1/2 feet shall be the minimum over the shoulders of all portions of the facility.

(2) *Minor Structures.* Pedestrian overcrossings shall have a minimum vertical clearance 2 feet greater than the standard for major structures for the State facility in question.

Sign structures shall have a vertical clearance of 18 feet.

(3) *26,000 Mile Priority Network.* This subset of the Interstate System is similar to what has previously been referred to as the National System of Interstate and Defense Highways. Those routes described in Table 309.2 and Figure 309.2 are given special attention in regards to minimum vertical clearance as a result of agreements between the FHWA and the Department of Defense. Vertical clearance for structures on this system shall meet the standards listed above for freeways and expressways. In addition to the standards listed above, vertical clearances of less than 16 feet over any portion of this system will be subjected to extensive review by FHWA and must be approved by the Military Traffic Management Command in Washington D. C. Documentation similar to, but less extensive than a Design Exception Fact Sheet must be submitted to FHWA to obtain approval for less than 16 feet of vertical clearance. See W. P. Smith's memo dated August 20, 1993 to District Directors for more information on the Priority Network.

(4) *General Information.* The standards listed above are the minimum allowable on the State Highway system for the facility and project type listed. For the purposes of these vertical clearance standards, all projects on the freeway and expressway system other than overlay projects shall be considered to be covered by the "new construction" standard.

When approved by a design exception (see HDM Index 82.2) clearances less than the values given above may be allowed on a case by case basis given adequate justification based upon engineering judgment, economic, environmental or right of way considerations. Typical instances where lesser values may be approved are where the structure is protected by existing lower structures on either side or where a project includes an existing structure that would not be feasible to modify to the current standard. In no case should vertical clearance be reduced below 15 feet over the traveled way or 14-1/2 feet over the shoulders over any portion of a State highway facility.

Efforts should be made to avoid decreasing the existing vertical clearance whenever possible and consideration should be given to the feasibility of increasing vertical clearance on projects involving structural section removal and replacement. Any project that would reduce vertical clearances below 16-1/2 feet or lead to an increase in the vertical clearance should be brought to the attention of the Project Development Coordinator and the District Permit Engineer at the earliest possible date.

(5) *Federal Aid Participation.* Federal-aid participation is normally limited to the following maximum vertical clearances unless there are external controls such as the need to provide for falsework clearance or the vertical clearance is controlled by an adjacent structure in a multi-structure interchange:

(a) Highway Facilities.

- o 17 feet over freeways and expressways.
- o 15-1/2 feet over other highways (14-1/2 feet over shoulders).
- o For pedestrian structures, 2 feet greater than the above values.

(b) Railroad Facilities.

- o 23 feet over the top of rails for non-electrified rail systems.
- o 24-1/4 feet over the top of rails for existing or proposed 25 kv electrification.
- o 26 feet over the top of rails for existing or proposed 50 kv electrification.

These clearances include an allowance for future ballasting of the rail facility. The cost of reconstructing or modifying any existing railroad-highway grade separation structure solely to accommodate electrification will not be eligible for Federal-aid highway fund participation. Where a rail system is not



US006000261A

United States Patent [19]

Johnston

[11] Patent Number: 6,000,261
[45] Date of Patent: Dec. 14, 1999

[54] **METHOD AND APPARATUS FOR PORTABLE SPIRAL PIPE MANUFACTURING**

[76] Inventor: Scott E. Johnston, 16857 Hummingbird La., Cottonwood, Calif. 96022

[21] Appl. No.: 09/212,048

[22] Filed: Dec. 15, 1998

Related U.S. Application Data

[60] Provisional application No. 60/069,620, Dec. 15, 1997.

[51] Int. Cl.⁶ B21C 37/12

[52] U.S. Cl. 72/49

[58] Field of Search 72/49, 50, 135, 72/137, 138, 142

[56] References Cited

U.S. PATENT DOCUMENTS

3,247,692 4/1966 Davis .
3,269,162 8/1966 Fay .
3,606,783 9/1971 Lewis .
4,070,886 1/1978 Nyssen .

OTHER PUBLICATIONS

Nokia Hevac Division, Trailer for Nokia HLS 4/60-E Mobile Travelling Spiral Duct Line (Catalog) 1980's Published in Finland—Shows Smaller Duct Machine in Custom

Trailer.

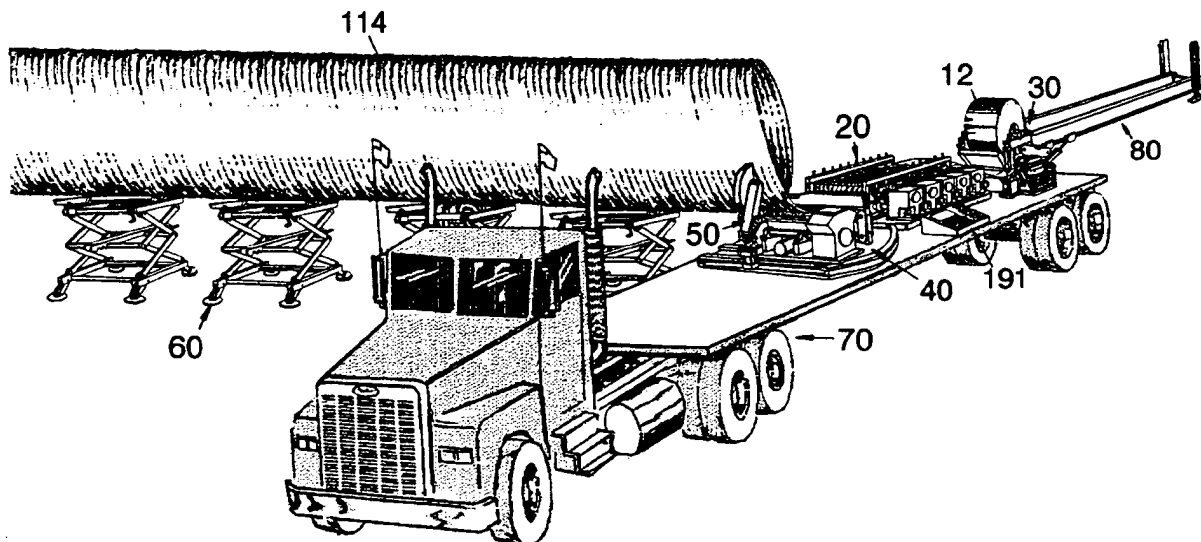
IMW Industries LTD., Culvert & Metal Forming Systems (Catalog) 1980's Published in Canada p. 2 Shows Standard Pipe Machine, p. 3 Shows Standard Pipe Machine on Custom Trailers.

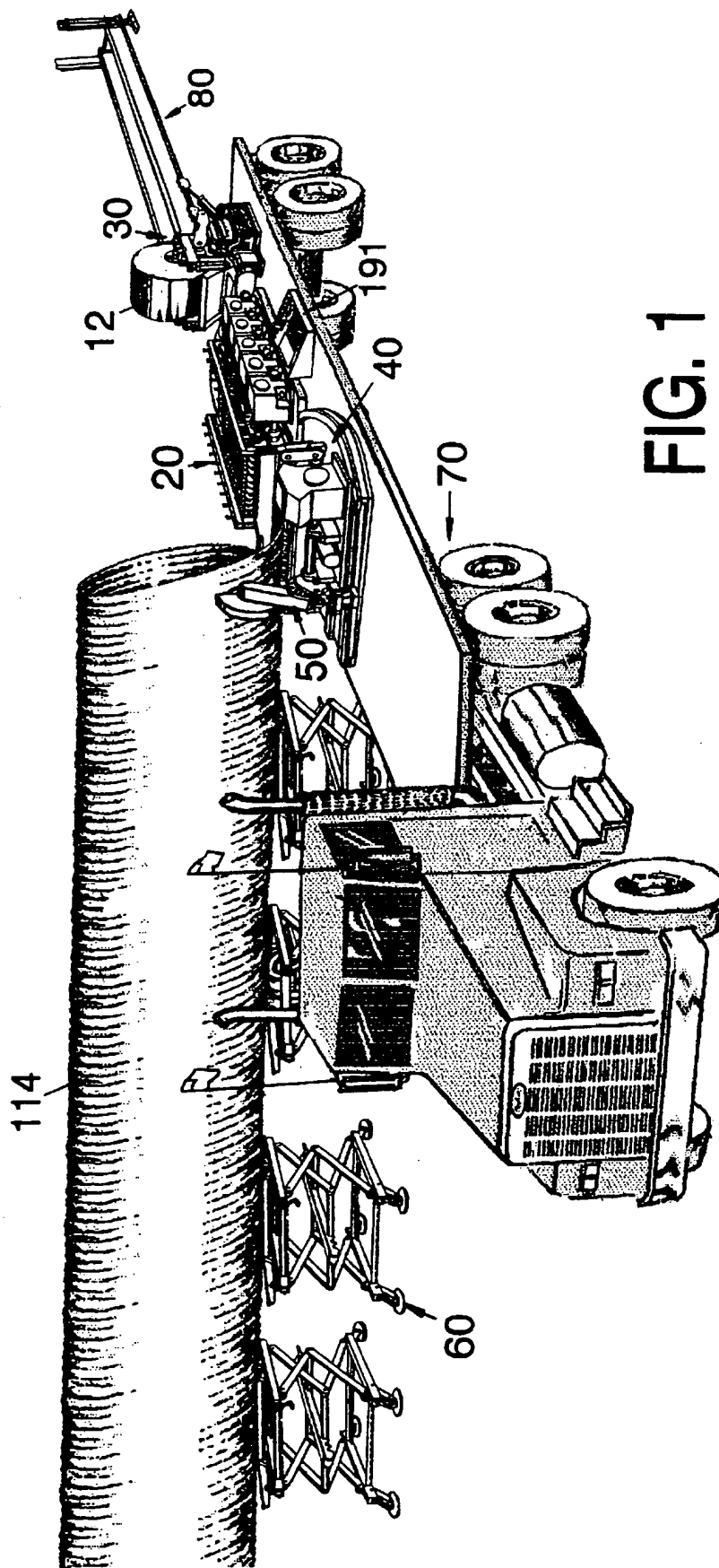
Primary Examiner—Rodney Butler

[57] ABSTRACT

A machine for spirally forming pipes that is readily transportable to various locations. The machine is mounted to the surface of a conventional tractor-trailer arrangement and includes an uncoiler assembly with a structural extension arrangement for transferring coils from delivery vehicles. The uncoiler assembly is pivotably mounted to allow for rotational travel to meet with coil delivery vehicles. Sheet material is uncoiled and fed to the spiral forming assembly by an assembly of cylindrical rollers with rotational energy provided by internal combustion engine. The spiral forming assembly is pivotably mounted with motorized connection and programmable control for helix angle and third set of rollers adjustment. The spiral forming assembly and the assembly of cylindrical rollers are mounted with bases of minimal height for stability. An internal combustion engine driven cut off assembly is mounted directly to the spiral forming assembly to cut off pipes as they are produced. The machine has multiple pipe support stands that may be stored on the tractor-trailer arrangement with the pipe machine, and quickly set up at various locations.

17 Claims, 7 Drawing Sheets





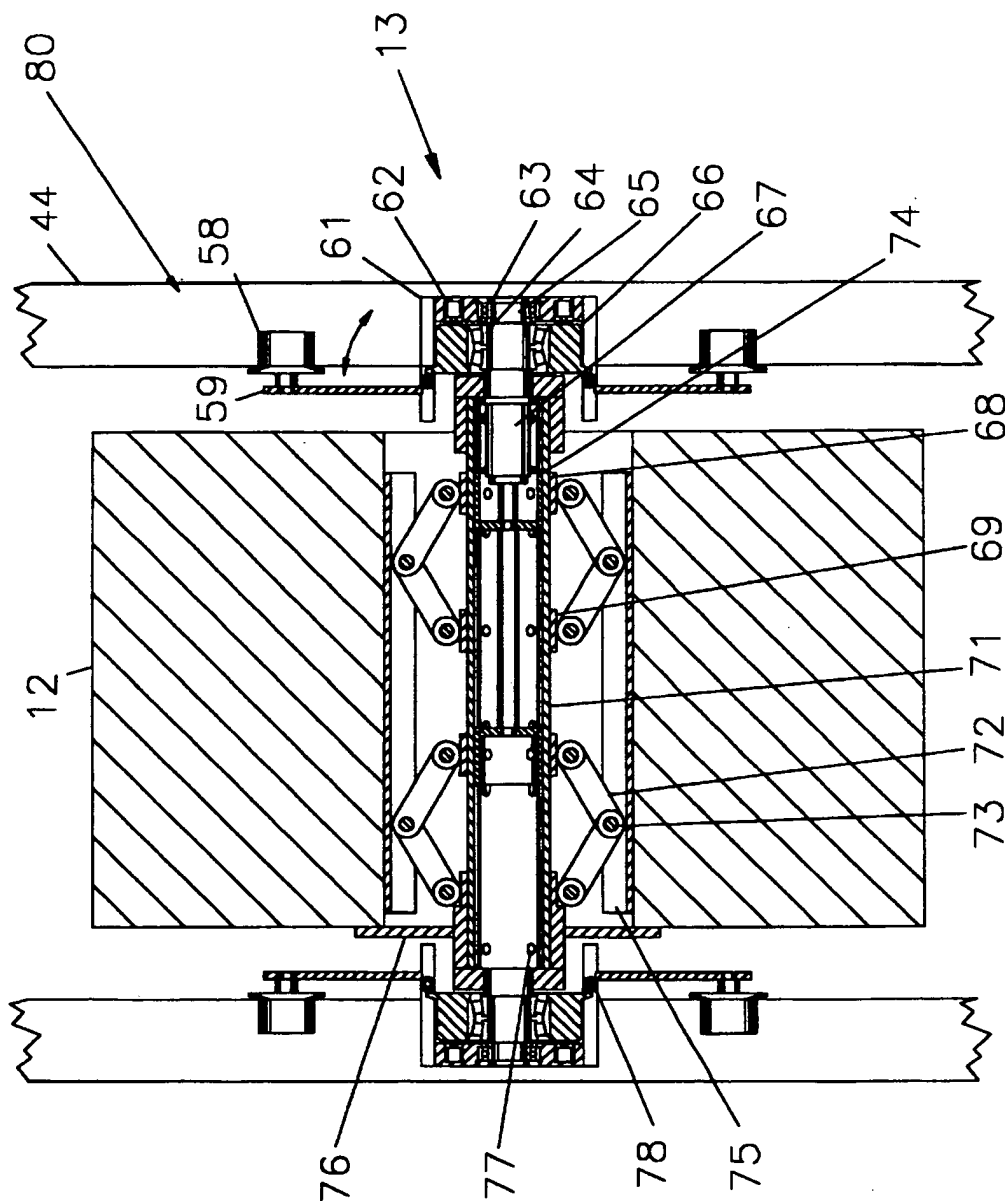
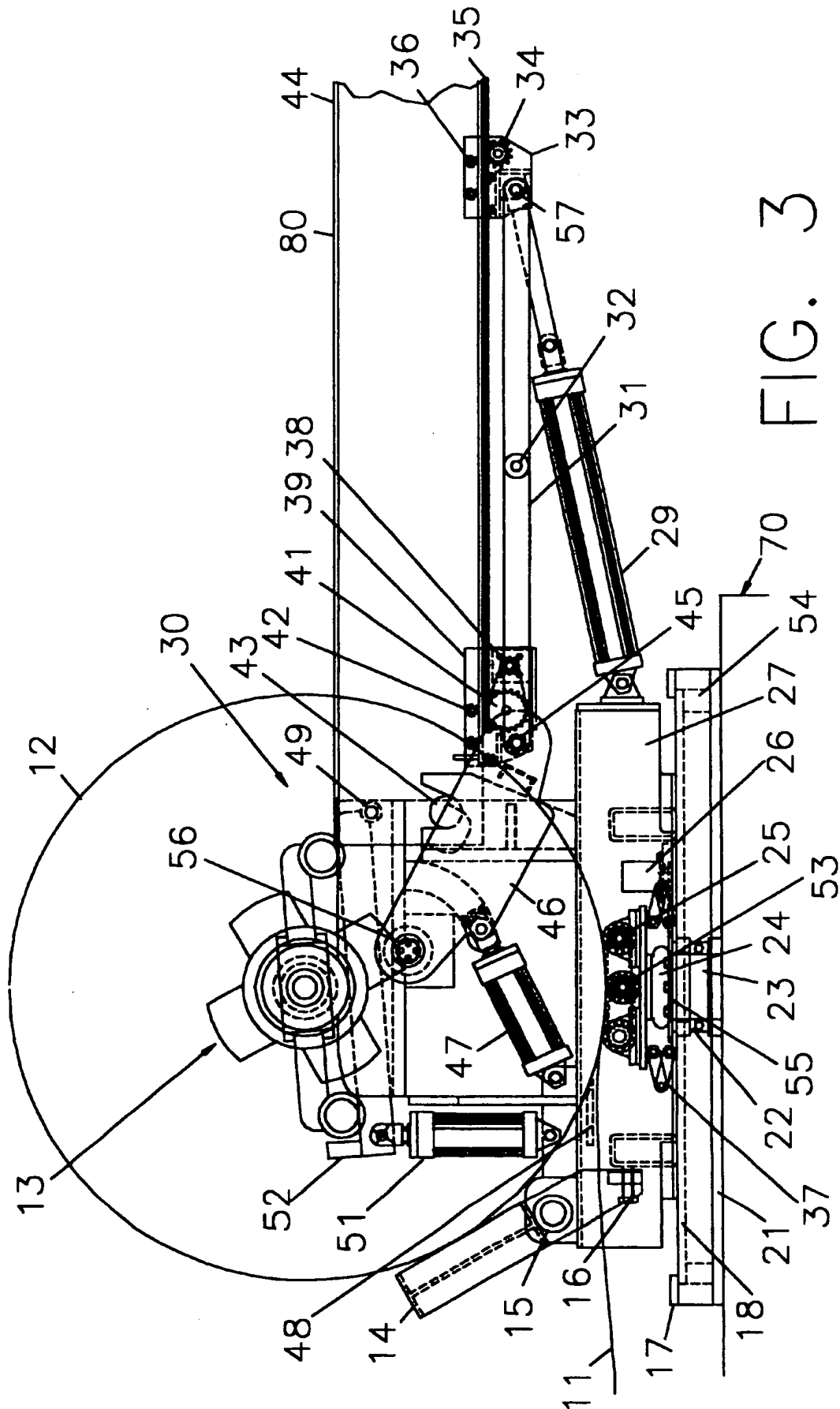


FIG. 2



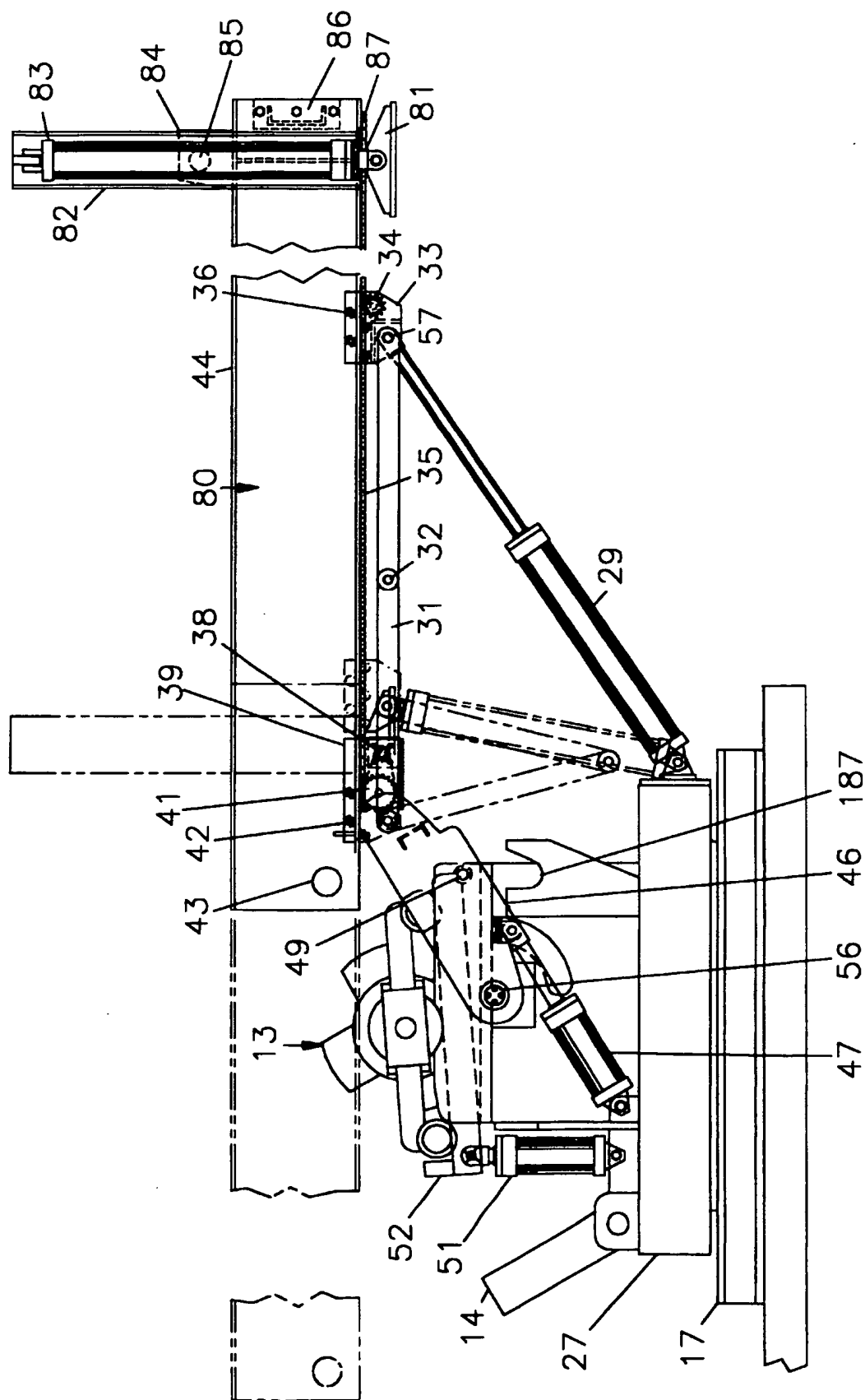


FIG. 4

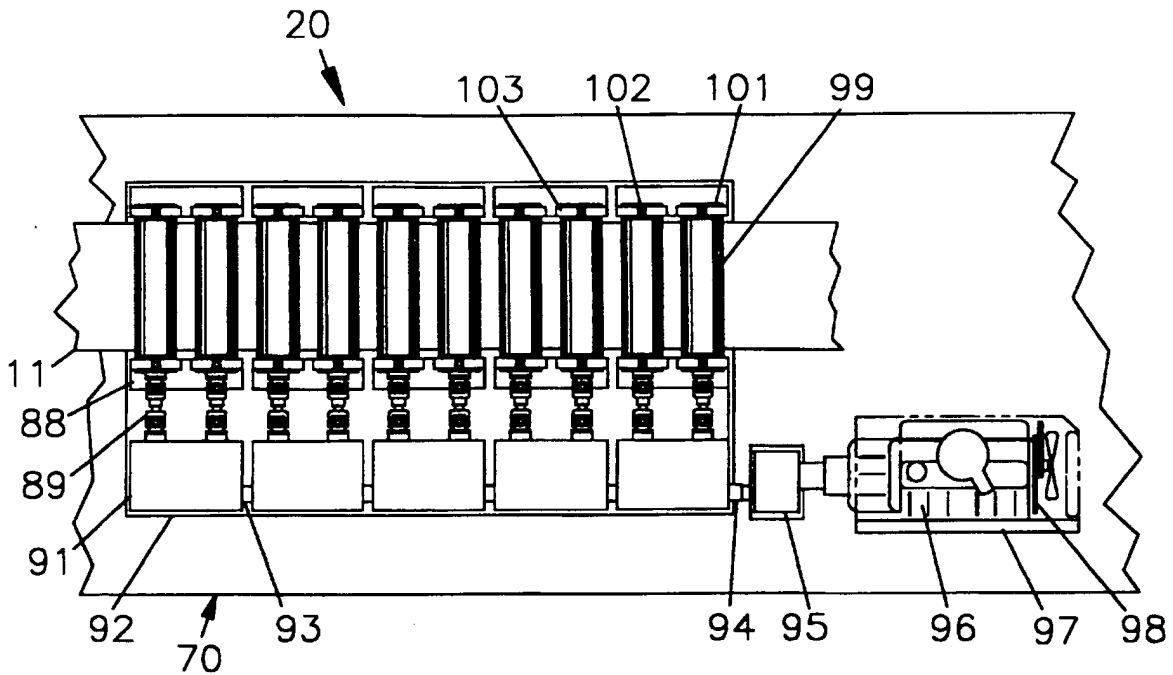


FIG. 5

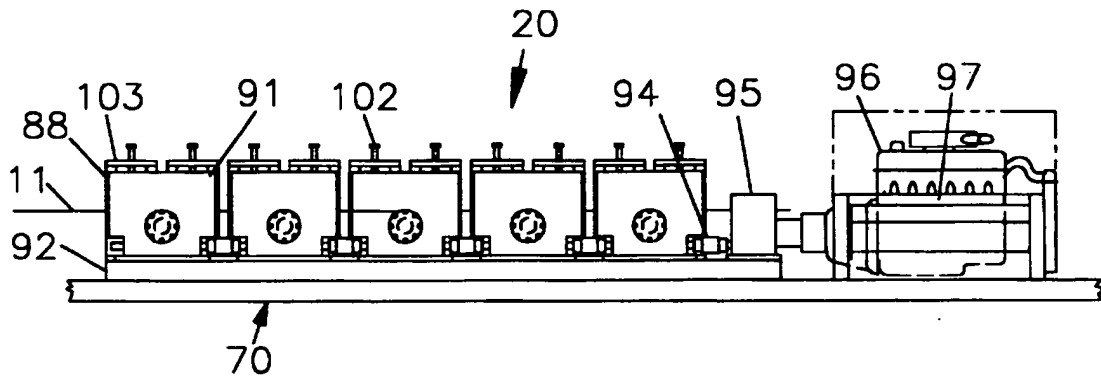
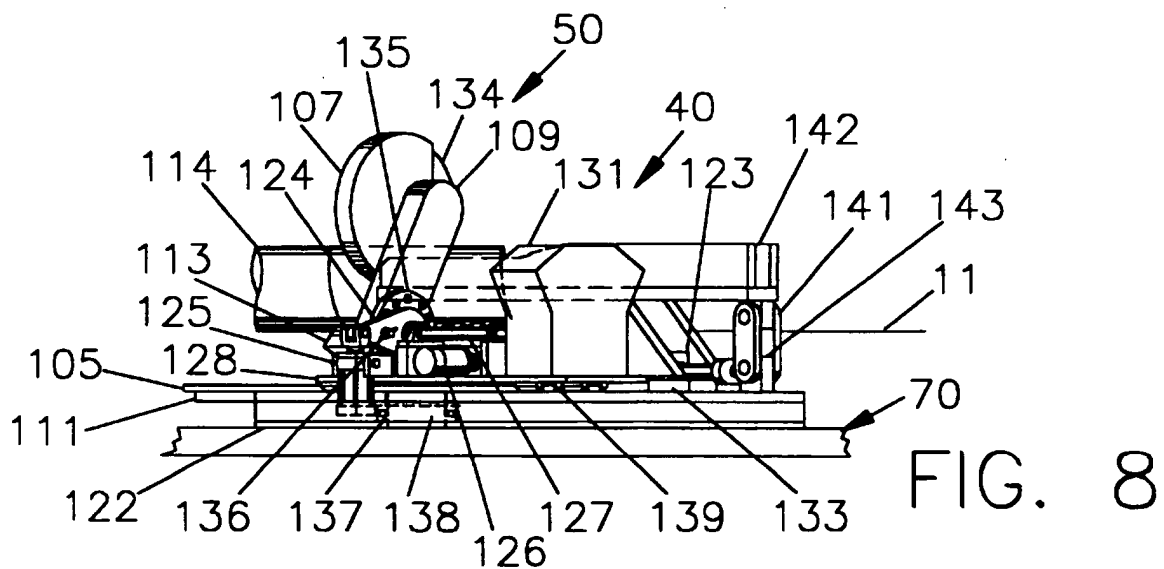
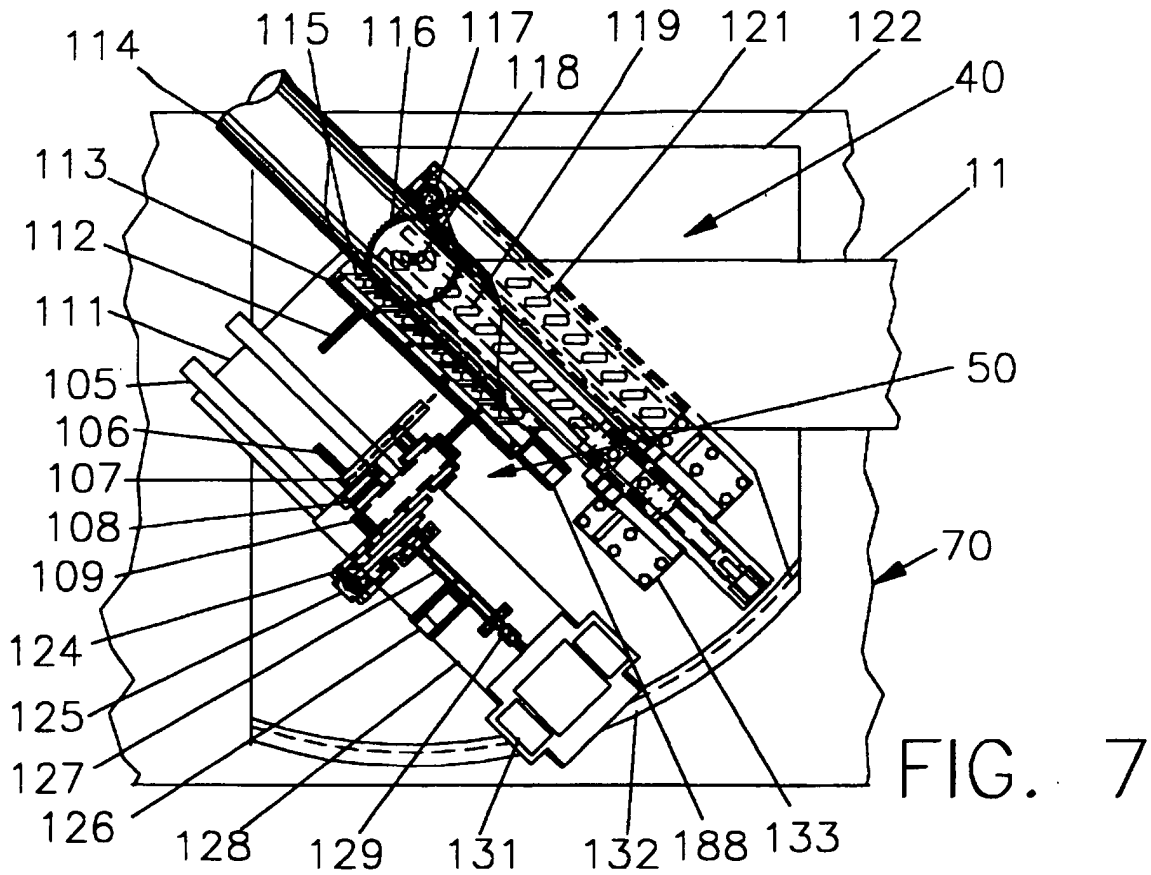


FIG. 6



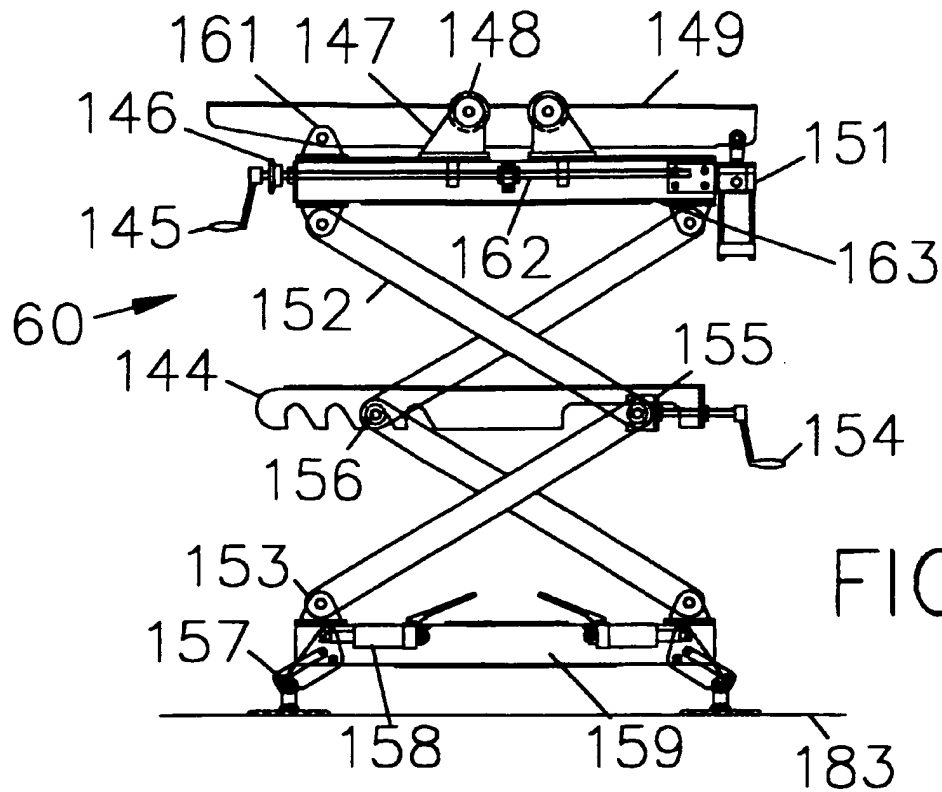


FIG. 9

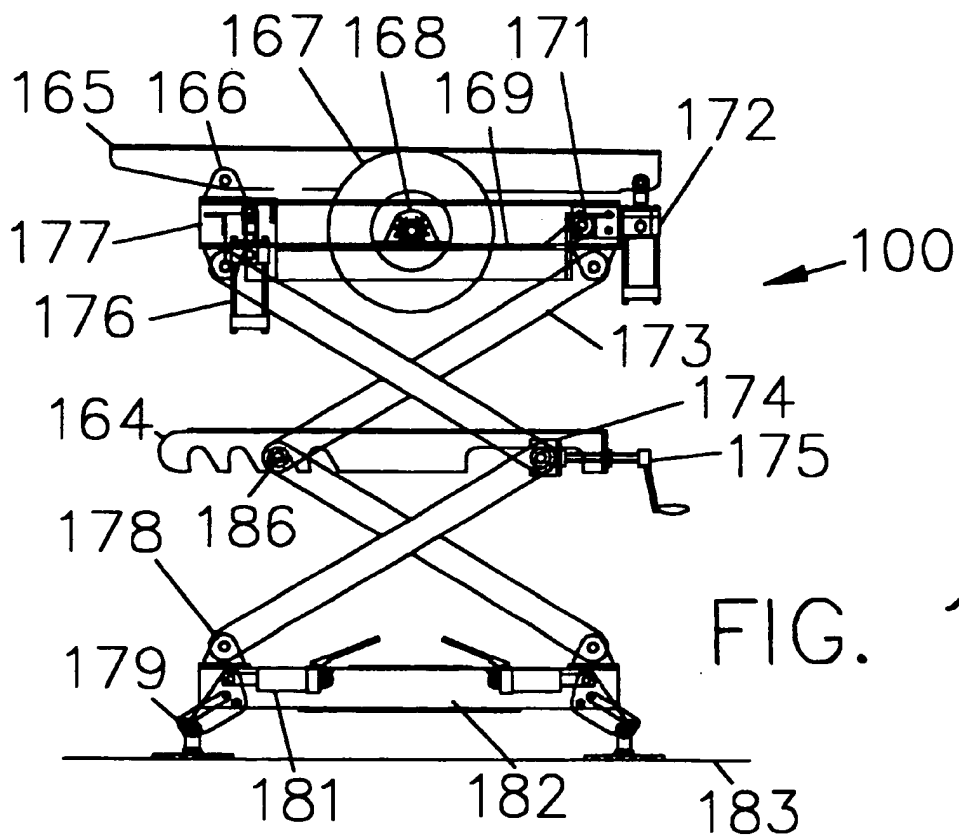


FIG. 10

1

METHOD AND APPARATUS FOR PORTABLE SPIRAL PIPE MANUFACTURING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of provisional patent application No. 60/069.620 Filed Dec. 15, 1997.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

REFERENCE TO MICROFICHE APPENDIX

Not Applicable

BACKGROUND OF THE INVENTION

This invention relates to a spiral pipe machine that can produce pipes at various locations.

Spiral pipe machines have been widely used for producing corrugated lockseam pipes and smooth welded seam pipes. These machines are most commonly found at factories throughout the country in locations within a two hundred mile radius of where the pipes produced will be used. These machines produce pipes from raw material of steel sheet in coil form. Common thickness of raw material ranges from 1 mm to 25 mm and common widths range from 0.5 meter to 1.5 meter with a typical coil weight of 10 tons. Pipes are produced on these machines in a range of sizes from 0.3 meter to 3.6 meter diameter and in lengths up to 12 meter. Spiral pipe machines all have in common equipment for uncoiling coils into sheet form, then feeding the sheet into a spiral pipe forming assembly and then onto a pipe support. Spiral pipe forming assemblies use lockseaming, welding or both to join material edges. Prior attempts were made to allow for spiral pipe machines to be transported to various locations for producing pipes. These machines had various disadvantages. One major difficulty is that these pipe machines required an electrical power source at the location they were traveling to, thus requiring a large generator or electrical hookup at location. Also ability to remove coils of raw materials from delivery vehicles and install the coil onto the uncoiler was not considered, thus requiring a special fork lift or some other type of equipment to perform this function at location. Another problem could be found in the fact that by using basically the same machines as they would use in factory installation, these machines required very specialized trailers to allow for manufacturing set up and in the case of larger machines special outriggers were required for stability, this also meant that these machines were not readily transportable. Because these machines were of standard factory machine height, the operator of the machine would need to stand on top of the customized trailer arrangement in order to operate the controls. Which was a safety concern. Since these machines were basically the same as the factory installed models, they were built with the same diameter and length capacities. One result being that only short lengths of pipe could be produced, longer lengths still required couplings.

BRIEF SUMMARY OF THE INVENTION

The invention comprises a machine for spirally forming pipes that is readily transportable to various locations. The machine includes an uncoiler assembly for uncoiling the steel sheet from raw material in coil form, an assembly of

2

cylindrical rollers for sheet feeding driven by an internal combustion engine, a spiral pipe forming assembly and means for pipe support. This machine is designed for mounting on a conventional trucking industry trailer. The sheet feeding and spiral pipe forming portions of the machine are designed of reduced height for safety and stability. The pipe support is designed to enable efficient set up at various locations. The uncoiler assembly is designed to allow for the transfer of coils from delivery vehicles.

It is the principal object of the present invention to provide a machine for the spirally forming of pipes that is readily transportable and not limited by the diameter and length considerations of the factory style machines.

This and other advantages of the present invention will become apparent from following the detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a perspective view of the portable spiral pipe forming machine mounted to the surface of a conventional flat bed tractor-trailer rig such as is common to the trucking industry with a coil of raw material as its formed into a spiral pipe being positioned thereon.

FIG. 2 is a cross sectional plan view of the means of traveling support of coils.

FIG. 3 is a side view of the uncoiler assembly and structural extension arrangement.

FIG. 4 is a side view of the uncoiler assembly with the structural extension arrangement in position for retracting.

FIG. 5 is a plan view of the assembly of cylindrical rollers with internal combustion engine.

FIG. 6 is a side view of the assembly of cylindrical rollers with internal combustion engine.

FIG. 7 is a plan view of the spiral forming assembly.

FIG. 8 is a side view of the spiral forming assembly.

FIG. 9 is a frontal view of a pipe support stand.

FIG. 10 is a frontal view of pipe support stand with driving wheels.

DETAILED DESCRIPTION OF THE INVENTION

Referring now in detail to the drawings, the present invention, a vehicle transportable apparatus for spirally forming pipes is most clearly shown in FIG. 1, comprising an uncoiler assembly 30, to support the coil 12, an assembly of cylindrical rollers 20 to feed the sheet of uncoiled material into the spiral forming assembly 40 for forming the pipe 114 onto the support stands 60.

Uncoiler assembly 30 with assembly of cylindrical rollers 20 and spiral forming assembly 40 are mounted to the surface of the tractor trailer arrangement 70 which provides ample room for storage of support stands 60 whereby the apparatus with all it comprises is transportable. The uncoiler assembly 30 includes a structural extension arrangement 80 and traveling coil support 13 as seen in FIGS. 2, 3 and 4. The traveling support 13 as most clearly shown in FIG. 2, comprises a pair of wheels 66 mounted with anti friction bearings 64 to extension shafts 65. Extension shafts 65 are a weldment tube and endcap that slip onto the tubular spindle 71. Both extension shafts 65 are secured to the tubular spindle 71 with multiple screws 77 spaced equally about their circumference. One extension shaft 65 has a coil stop ring 76 welded to it. The pair of wheels 66 provide for

radial travel of the traveling coil support 13 upon the structural extension arrangement 80. A plurality of extension arms 59 and rollers 58 extend in either direction out from the center of the traveling coil support 13, to provide for rolling alignment. Rollers 58 are mounted with anti-friction bearings and threaded studs (not shown) to the extension arms 59. Extension arms 59 are pivotably mounted to the extension arm frame 61. Extension arms 59 swing in to allow for insertion of traveling support 13 into coil 12. Extension arm frame 61 is mounted to an anti-friction bearing 63 which is mounted to the extension shaft 65. A plurality of inner slide rings 74 fit inside tubular spindle 71 and are attached to a matching plurality of outer slide rings 68. They are secured with multiple shoulder screws placed equally about their circumference to allow for slideable movement with relationship to elongated slots provided in tubular spindle 71. A hand operated type hydraulic cylinder 67 with extension, is mounted to the inside end of one extension shaft 65, inside tubular spindle 71 and extended to connect with and act upon the inner slide rings 74. Tubular spindle 71 is fitted with a fixed ring 69, with pivot lugs welded to it (not shown). The fixed ring 69 is secured in place with multiple screws equally spaced about its circumference. The extension shaft 65 with the coil stop ring 76 welded to it, also has pivot lugs welded to it (not shown). A plurality of pivot links 72 are mounted to pivot lugs on 65 and 69 with pivot pins 73 providing a fixed pivot point along the length of the tubular spindle 71. The outer slide rings 68 also have pivot lugs welded to them (not shown), providing a sliding pivot point along the length of the tubular spindle 71. A plurality of pivot links 72, are mounted to pivot lugs on outer slide rings 68, with pivot pins 73. A plurality of coil leafs 75, including pivot lugs are secured to both sets of links 72, those from the fixed pivot attach from one direction, and those from the sliding pivot attach from the opposite direction, connected with pivot pins 73. A plurality of brake cylinders 62 are mounted in extension arm frame 61 to act upon wheels 66 to provide for speed control of traveling coil support 13. Several different embodiments of a traveling coil support could be employed with the present invention, and traveling coil support 13 is merely illustrative of one such embodiment.

Referring now to uncoiler assembly 30 as shown in FIGS. 3 and 4 including a structural extension arrangement 80, which comprises a plurality of structural beams 44 generally secured to the uncoiler assembly 30 with pivot pin 43 pivotably resting in saddle 187 of uncoiler frame 27 and interconnected to a plurality of pivot links 46 pivotably mounted on pivot pin 56 to uncoiler frame 27. Pivot links 46 are interconnected to structural beams 44 with lifting brackets 39 by multiple cam followers 42, which sandwich the lower flange of structural beams 44 while pivot pin 45 connects lifting brackets 39 to pivot links 46. Pivot links 46 actuated by hydraulic cylinder 47 provide for lifting of structural beams 44 for retracting (see FIG. 4). Hydraulic cylinder 47 is end clevis mounted to uncoiler frame 27 and rod clevis mounted to pivot links 46. Lifting brackets 39 provide mounting for hydraulic motor with chain and sprocket 38 and shaft with sprocket 41. Shaft with sprocket 41 are mounted to lifting bracket 39 with anti-friction bearings. Shaft with sprocket 41 mesh with chain 35 to provide for linear travel of structural beams 44. Chain 35 is mounted directly to structural beams 44 with screws and is secured along full length of structural beams 44. Sliding lift brackets 33 are connected to structural beams 44 with multiple cam followers 37 which sandwich lower flange of structural beams 44. Brackets 33 are equipped with an idler

sprocket 34 which is mounted to brackets 33 with anti-friction bearings (not shown). Hydraulic cylinder 29 acts upon sliding lift brackets 33 to adjust height of structural beams 44 for lifting coils or retracting structural beams 44 for travel. Hydraulic cylinder 29 is end clevis mounted to uncoiler frame 27 and rod clevis mounted to sliding lift brackets 33 with pin 57. A plurality of links 31 connect from pivot pin 45 of pivot links 46 to link pin 32 and to pin 57 of sliding lift brackets. These links 31 limit the linear travel of sliding lift brackets 33 to ensure lifting action from cylinder 29. These links 31 further allow the retracting of structural beams 44 by folding down when structural beams 44 are retracted (see FIG. 4). On the extended end of structural beams 44 a pair of hydraulic cylinders 83 are end clevis mounted to a pair of vertical mounts 82 which are pivotably mounted on pins 85 to brackets 84 which are welded to structural beams 44. A guiding bracket 87 is slidably mounted to extendible rod end on hydraulic cylinders 83 and rigidly mounted to vertical mounts 82. A pair of lifting feet 81 are rod clevis mounted to hydraulic cylinders 83. A structural crossmember 86 is mounted between structural beams 44 for rigidity. Lifting feet 81 rest on surface of coil 12 delivery vehicle (not shown). Hydraulic cylinders 83 provide lifting force to raise structural beams 44 to allow gravitational travel of coil 12, secured by traveling coil support 13, thus providing effective transfer of coil 12 from delivery vehicles (not shown), to uncoiler assembly 30.

The uncoiler assembly 30 shown in FIG. 3 further includes hydraulic cylinders 51, end clevis mounted to uncoiler frame 27 and rod clevis mounted to ejector arms 52. Ejector arms 52 are pivotably mounted to pivot pin 49, hydraulic cylinders 51 act upon ejector arms 52 to lift on and cause traveling coil support 13 to roll off uncoiler assembly 30, and onto structural extension arrangement 80, so that it may be used to transfer a new coil 12. A coil stop frame 14 is pivotably mounted to the uncoiler frame 27 with a pair of pivot pins 16 and is adjustable by adjust screw 16. Coil stop frame 14 is there to prevent coil 12 from over traveling in case of operator error or brake malfunction. The top portion of uncoiler frame 27 has a recessed area (or saddle) conforming to the radial shape of wheels 66 on traveling coil support 13. This recessed area provides for securing of the traveling coil support 13, when a coil 12 is loaded onto the uncoiler assembly 30. The uncoiler frame 27 is rigidly mounted to the uncoiler base plate 18, which is pivotably mounted over pivot pin 23 to the substantially flat surface of the uncoiler platform 21. Uncoiler platform 21 is mounted directly to the tractor-trailer rig 70. A gib and spacer 17 secure the outer circumference of the uncoiler base plate 18 allowing it to slide rotationally while holding down on its periphery. Gib and spacer 17 are mounted to the uncoiler platform 21. A sliding member 54 is mounted to the underside of the uncoiler base plate 21, to nearly match the inside height of the gib and spacer 17. An anti-friction thrust bearing 22 is mounted between uncoiler base plate 18 and uncoiler platform 21. A large sprocket 55 is mounted to the top of pivot pin 23. A hydraulic motor with sprocket and chain 26 are mounted to the uncoiler base plate 18, and connected to large sprocket 55, thus providing rotational energy to allow for rotational travel of uncoiler assembly 30, relative to the uncoiler platform 21. This allows for rotational travel to match with position of coil 12 delivery vehicles (not shown). A pair of pneumatic air bag type actuators with a plate mounted on top 24 is mounted to the top surface of the uncoiler base plate 18. A pair of elongated rollers 25 are mounted with pillow block bearings to the plate on top of 24. These elongated rollers 25 are driven by

5

a hydraulic motor 53 with chains and sprockets, multiple scissor links 37, provide guiding for pneumatic air bag type actuators with plate mounted on top 24, when acted upon, this brings elongated rollers 25 in contact with coil 12. Hydraulic motor 53 can then rotate coil 12 forward or back. A peeling bar 48 is mounted to the uncoiler frame 27 in such a position as to peel sheet 11 from coil 12, as coil 12 is rolled forward.

Referring now to FIGS. 5 and 6, an assembly of cylindrical rollers 20 comprising a plurality of elongated cylindrical rollers 99 (profiled or smooth depending on type of pipe) are positioned both above and below sheet 11, to provide for rolling, pinching contact. Cylindrical rollers 99 are mounted with anti-friction bearings inside vertically slidable bearing blocks 101. Bearing blocks 101 are secured in a plurality of roll stand frames 88, with the lower cylindrical rollers 99 fixed in height, while the upper cylindrical rollers 99 are adjustable in height to match material thickness of sheet 11. Adjustment is accomplished with vertical adjust screws 102, threadedly mounted through cap bars 103, and to the top of bearing blocks 101 supporting the upper cylindrical rollers 99. Roll stand frames 88 are mounted to a minimal height base frame 92. Cylindrical rollers 99 are rotationally coupled to gearbox 91 with rotational coupling device 89. Multiple gearboxes 91, when required are rotationally coupled with rotational coupling device 93. Gearbox(s) 91 are mounted to the minimal height base frame 92 and base frame 92 is mounted to the surface of the tractor trailer arrangement 70. An internal combustion engine and transmission 96, is mounted with a frame and cover 97, to the surface of the tractor trailer arrangement 70, as a part of cylindrical roller assembly 20 and is rotationally coupled through rotational coupling device 94 and 95. Internal combustion engine and transmission 96 provides rotational energy and for controllably coupling rotational energy to the cylindrical roller assembly 20. Internal combustion engine and transmission 96 provides rotational energy for support apparatus, transmitted with belts and pulleys 98, support apparatus includes, hydraulic pump (not shown), air compressor (not shown) and generator (not shown).

Referring now to FIGS. 7 and 8 spiral forming assembly 40 comprising, three sets of rollers 121, 119 and 115. The first set of rollers 121 (commonly referred to as the lead roll assembly), includes multiple yoke mounted rollers secured to a base plate which is mounted to the three roll table 111, the second set of rollers 119 (commonly referred to as the mandrel roll assembly) includes multiple yoke mounted rollers secured to the underside of the mandrel 142, the third set of rollers 115 (commonly referred to as the buttress roll assembly) includes multiple yoke mounted rollers secured to a base plate that is mounted to a wedged shaped support 113 that is slidably mounted to the three roll table 111. The incoming sheet 11 rolls over the top of the first set of rollers 121 and then under the second set of rollers 119 and then is pushed up by third set of rollers 115. This puts a radius into the sheet 11 which is the result of the third set of rollers 115 position, in toward the second set of rolls 119 for smaller diameters, or out farther away from the second set of rolls larger diameters, all three sets of rollers 121, 119 and 115 are mounted pivotably to align perpendicularly to the incoming sheet 11, while the three roll table 111 which is pivotably mounted to the substantially flat surface of the three roll platform 122 is rotationally positioned at a predetermined helix angle relative to the incoming sheet 11 for a given diameter, this allows the edges to meet as sheet 11 curves up and over to form pipe 114. A pair of rollers located generally

6

at 118 above and below the incoming sheet 11 are used to assist in the seaming of edges as they meet, for welded seam pipe these rolls straddle the edges one under sheet 11 and the other over the sheet 11 as it is just becoming pipe 114 with a welding head (not shown) located atop the seam between. For lockseam pipe these rollers 118 act as seam closing rolls for the incoming edges of sheet 11 where the edges have been rollformed with engagement lips (not shown). In both cases whether welding or lockseaming these rollers located generally at 118 are used to affect diameter as well as assist in seaming, by raising or lowering the rollers, small alterations in diameter can be made. The three roll table 111 is pivotably mounted to the three roll platform 122 with pivot pin 138. It is important that the pivot pin 138 be directly under seaming line edge of sheet 11 as shown in FIG. 7, an anti-friction thrust bearing 137, is mounted between the three roll table 111 and three roll platform 122. A large sprocket 116 is mounted to the top of pivot pin 138. A servo motor with sprocket and chain 117 are mounted to the three roll table 111 and connected to large sprocket 116, thus providing rotational energy to allow for rotational travel of spiral forming assembly 40, relative to the three roll platform 122. A gib and spacer 132 secure the outer circumference of the three roll table 111 allowing it to slide rotationally while holding down on it's periphery. A gib and spacer 132 are mounted to the three roll platform 122, a sliding member (not shown) is mounted to the underside of the three roll table 111 to nearly match the inside height of the gib and spacer 132. Mandrel 142 is pivotably mounted to the three roll table 111 with mandrel stands 133. The mandrel 142 may be pivoted up out of the way for servicing when needed by actuating hydraulic cylinder 123 which is end clevis mounted the three roll table 111, and rod clevis mounted to the link slide bracket 143. The link slide bracket 143 is slidably mounted to the three roll table, as links 141 are pulled back by hydraulic cylinder 123, links 141 pull down on mandrel 142. A laser level (not shown) is mounted to the side of mandrel 142 to provide a line of sight level for the pipe support stands 60 (not shown). The slidably mounted wedged shaped support 113, is adjustable in and out in relationship to the second set of rollers 119, along a pair of gear racks 112. A servo motor 188 connects to pinion gears (not shown) to provide the rotational energy to affect the linear position. Both servo motor 188 and servo motor with chain and sprocket 117 is interconnected for electric controllability to a programmable control unit in the control console 191.

The cut off assembly 50 shown most clearly in FIGS. 7 and 8 comprises a pair of linear rails 105 mounted to the three roll table 111. A slide plate 128 mounted with linear travel slide blocks 139. An internal combustion engine 131 is mounted to the slide plate 128 to provide rotational energy to a saw blade 134, a rotary coupling device 129 connects engine 131 to shaft 127 which is supported between pillow blocks 124 and 108 and drives a rotary coupling arrangement 109, which transfers rotational energy to the saw blade 134. Adjust ring 135 directly mounts to the rotary coupling arrangement 109 to allow for angular positioning of saw blade 134 relative to the size of pipe produced. Actuator bracket 124 is connected to adjust ring 135 with connecting pin 136. Hydraulic cylinder 125 is trunion mounted with bars to slide plate 128 and rod clevis mounted to actuator bracket 124. The saw blade guard 107 is provided as a safety device. A servo motor 126 is mounted to slide plate 128 and provides rotational energy to a pinion gear (not shown), that translates the rotational energy into linear travel along rack 106. Servo motor is interconnected for electric controllability to a programmable control unit in the control console 191.

Referring now to FIG. 9 pipe support stands 60, comprising a base frame 159, with feet 157 mounted to hand pump leveling jacks 158, in four corners contacting the ground 183. Scissor links 152 mount to pivot brackets 153 and provide for vertical height adjustment, as well as reducing height for storage upon tractor trailer arrangement 70 (not shown). Crossmember shafts 156 are mounted at central pivot locations between base 159 and table 163. An adjust frame 144 straddles the two crossmember shafts 156 and assists in vertical adjustment with adjust block 155 connected to adjust screw 154. Adjust frame 144 has several engagement slots for a wide range of height adjustment. Table 163 has a plurality of elongated rollers 148 mounted to adjust brackets 147 and connected to threaded shaft 162 with both right and left handed threads to allow for simultaneous adjustment in and out of adjust brackets 147. Sprocket 146 connects to other screw 162 to allow for parallel adjustment of brackets 147 with handle 145. Kick off arm 149 is pivotably mounted to the top of table 163 with pivot mount 161 and is actuated by cylinder 151 which is trunion mounted to table 163 and rod clevis mounted to kick off arm 149. This allows for pipe 114 (not shown) removal. As many stands as required to support pipe lengths, may be used. Each support stand is fitted with a wire frame target (not shown) for line of sight leveling in relationship to the laser level mounted to the spiral forming assembly 40 (not shown).

Referring now to FIG. 10, pipe support stand with accelerator rolls 100, comprising a base frame 182 with feet 179, mounted to hand pump leveling jacks 181, in four corners contacting the ground 183. Scissor links 173 mount to pivot brackets 178 and provide for vertical height adjustment, as well as reducing height for storage upon tractor trailer arrangement 70 (not shown). Crossmember shafts 186 are mounted at central pivot locations between base 182 and table 177. An adjust frame 164 straddles the two crossmember shafts 186 and assists in vertical adjustment with adjust block 174 connected to adjust screw 175. Adjust frame 164 has several engagement slots for a wide range of height adjustment. Table 177 has a drop frame 169 mounted to pivot mounts 171, and actuated by cylinder 176 which is trunion mounted to table 177 and rod clevis mounted to drop frame 169. A pair of tires 167 are mounted with pillow blocks 168 to drop frame 169. The tires 167 are driven by direct connected hydraulic motor (not shown). Tires 167 are raised and lowered by hydraulic cylinder 176 to contact lower circumference of pipe (not shown). Tires are positioned with pipe helix angle to spin pipe out beyond the machine after cutoff. Kick off arm 169 is pivotably mounted to the top of table 177 with pivot mount 166, and is actuated by cylinder 172 which is trunion mounted to table 177 and rod clevis mounted to kick off arm 165. This allows for pipe 114 (not shown) removal from pipe support stand 100. This support stand is fitted with a wire frame target (not shown) for line of sight leveling in relationship to the laser level mounted to the spiral forming assembly 40 (not shown).

Various changes and modification may be made in carrying out the present invention without departing from the spirit and scope thereof. Insofar as these changes and modifications are within the purview of the appended claims, they are to be considered as part of the invention.

I claim:

1. A vehicle transportable apparatus for spirally forming pipes from steel sheet in coil form comprising means for supporting said coil in an uncoiler assembly and allowing for uncoiling means for feeding and rotationally driving said sheet from said coil into means for curving up said sheet

while joining its edges for forming said pipes and onto means for supporting and unloading said pipes that have been formed whereby said apparatus will be readily transportable to various locations.

2. The combination of claim 1 further including means for transferring said coil to said uncoiler assembly comprising a structural extension arrangement that extends horizontally from said uncoiler assembly to allow for travel of said coil.

3. The combination of claim 1 wherein said uncoiler assembly includes means for rotational travel comprising a motor for providing rotational energy coupled to said uncoiler assembly with rotational pivot connection to a substantially flat surface that provides for rotational slidability.

4. The combination of claim 1 wherein said means for feeding and driving said sheet includes an assembly of cylindrical rollers mounted to a base frame of minimal height.

5. The combination of claim 1 wherein said means for curving up said sheet while joining its edges for forming said pipes includes a spiral forming assembly mounted to a base frame of minimal height.

6. The combination of claim 1 further including a cut off assembly for cutting said spirally formed pipes to predetermined lengths comprising, means for cutting said pipes mounted to a horizontal traveling plate arrangement that is slidably attached to said means for curving up said sheet while joining its edges for forming said pipes.

7. The combination of claim 1 wherein said means for supporting and unloading said pipes includes a plurality of rollers mounted with bearings connected to a frame structure providing means for vertical adjustment and leveling of said means for supporting and unloading said pipes.

8. The combination of claim 4 wherein said assembly of cylindrical rollers includes an internal combustion engine for producing rotational energy and means for controllably coupling rotational energy from said engine to said assembly of cylindrical rollers.

9. The combination of claim 5 wherein said spiral forming assembly includes pivotable mounting to a substantially flat surface with a motor for controllably adjusting said spiral forming assembly whereby said pivotable mounting allows for positioning of said spiral forming assembly in relationship to said means for feeding and driving said sheet.

10. The combination of claim 5 wherein said spiral forming assembly further comprises three sets of rollers, one set of said rollers, includes, a slidably mounted wedge shaped support with a means of rotational energy to affect linear position, connected with means of programmable control, whereby said means of programmable control enables more efficient set up.

11. The combination of claim 9 wherein said spiral forming assembly includes said pivotable mounting with said motor for controllably adjusting said spiral forming assembly connected to a means of programmable control whereby said means of programmable control enables more efficient set up at various locations.

12. The combination of claim 7 wherein said means of vertical adjustment and leveling also provides for compactability whereby said means for supporting and unloading said pipes is readily transportable.

13. A vehicle transportable method of spirally forming pipes from steel sheet in coil form comprising the steps of transporting said method to a location where said pipes will be used, transferring said coil, unrolling said coil into said sheet, feeding said sheet, forming said sheet into said pipes and supporting said pipes.

9

14. The method of claim 13 further including the step of rotating an uncoiler assembly while preparing for said transferring of said coil, whereby said transferring can be performed from various positions.

15. The method of claim 13 wherein said transferring of said coil includes the step of lifting on a plurality of beams whereby said lifting allows for gravitational travel of said coils.

10

16. The method of claim 13 further including the step of adjusting said forming, whereby said step of adjusting said forming, is performed to produce diameters of nearly unlimited range.

17. The method of claim 13 wherein said supporting said pipes, includes the step of moving supports to accommodate pipe lengths, whereby longer lengths of pipe may be produced.

* * * * *